| | $X = 0$ | $X = 1$ |
|---|---|---|
| $Y =$ Frosh | 0.01 | 0.13 |
| $Y =$ Soph | 0.05 | 0.33 |
| $Y =$ Junior | 0.04 | 0.21 |
| $Y =$ Senior | 0.03 | 0.12 |
| $Y = 5+$ | 0.02 | 0.06 |

What is the probability that a student's favorite digit is 0, $P(X = 0)$? We can use the LOTP to compute this probability:

$$\begin{aligned}
\text{P}(X = 0) &= \sum_y \text{P}(X = 0, Y = y) \\
&= \text{P}(X = 0, Y = \text{Frosh}) \\
&\quad + \text{P}(X = 0, Y = \text{Soph}) \\
&\quad + \text{P}(X = 0, Y = \text{Junior}) \\
&\quad + \text{P}(X = 0, Y = \text{Senior}) \\
&\quad + \text{P}(X = 0, Y = 5+) \\
&= 0.01 + 0.05 + 0.04 + 0.03 + 0.02 = 0.15
\end{aligned}$$

# Marginalization with More Variables

The idea of marginalization can be extended to joint distributions with more than two random variables. Consider having three random variables $X$, $Y$, and $Z$, we could marginalize out any of the variables:

$$\begin{aligned}
P(X = x) &= \sum_{y,z} \text{P}(X = x, Y = y, Z = z) \\
P(Y = y) &= \sum_{x,z} \text{P}(X = x, Y = y, Z = z) \\
P(Z = z) &= \sum \text{P}(X = x, Y = y, Z = z)
\end{aligned}$$